STATE WATER RESOURCES
CONTROL BOARD

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DIV. OF WATER RIGHTS
SACRAMENTO

The Bay Institute

October 8, 2008

Tam Doduc, Chair
State Water Resources Control Board
P.O. Box 2000
Sacramento, CA 95814-2000

RE: ISSUES FOR PERIODIC REVIEW OF BAY-DELTA PLAN AND EVIDENTIARY HEARINGS

Dear Chair Doduc,

This letter is submitted as the comments of the Bay Institute regarding issues to be considered during the upcoming periodic review of the 2006 Bay-Delta Water Quality Control Plan (Bay-Delta Plan) and the upcoming fact-finding evidentiary hearings, pursuant to the Strategic Plan adopted by the Board in June. We will summarize these comments in our oral presentation to the Board at today's workshop.

<u>Restoring the natural salinity variability of the Bay-Delta estuary is desirable, but should be based on historical conditions and organism tolerance ranges</u>

The natural variability of salinity and freshwater inflows characteristic of the pre-development Bay-Delta estuary has been dramatically reduced by water development and land conversion throughout the watershed. The development of the X2 standard and its adoption by the Board in the 1995 Bay-Delta Plan was a major step toward restoring this natural variability. A number of parties have proposed that variability needs to be further restored in order to better protect native estuarine resources and discourage colonization by exotic species.

Two principles should guide the Board's evaluation of the effects of restoring salinity variability on estuarine habitat. First, historical conditions prior to large-scale water development and land conversion should be accurately described and, to the maximum extent feasible, replicated as a guide for future management regimes. Enough measurements and calculated data are available to characterize the pre-project but altered Delta and Suisun Marsh salinity regime in the first four decades of the 20th century, and the salinity regime through the various stages of project development and water management over the past 65 years, as well as the unimpaired salinity with the current Delta and Suisun Marsh configuration. The 19th century and pre-development salinity can be broadly characterized from historical accounts, historical landscape reconstructions, and paleo records (Bay Institute, P. 2-71 to 2-73, 4-17, 4-18). The evidence indicates that the natural Delta was fresh most of the year and in most years but that slightly brackish water (2 pt) could intrude into the western part of the Delta from Suisun Marsh during the lowest flow period of late summer and early autumn and could have extended further into the Delta in extreme droughts. In the first two decades of the 20th century the Delta stayed fresh through much of the year but the prolonged dry period in the 1920's and 1930's combined with increasing upstream diversions allowed brackish conditions to extend up into the Delta more often and earlier in the summer compared to the pre-development conditions. Water project operations in the middle part of the 20th century were able to keep brackish water from moving as far eastward into the Delta in the late summer and early fall. Diversions and project operations have reduced the frequency at which low salinity water occurs in Suisun Marsh and moved it upstream – eastward- into the Delta. The effect of water management, land reclamation, and channel straightening and deepening is to make the Delta more saline and reduce the area which experiences variable salinity.

Much of the perceived disagreement about historic salinity variability and the role of project operations in changing the variability can be ascribed to different ways of characterizing the geography of the Delta and Suisun Marsh and different ways of using terms such as "variability", "historic", and "fresh/brackish/salty." For example, in describing the western Delta as an area of natural variable salinity, different commentators refer to an area ranging from Chipps Island to beyond Sherman Island – so generalizations about the salinity in this area can be misleading if not carefully defined. The Board should describe historic Delta and Suisun Marsh salinity variability using carefully defined terminology and geography in order to minimize the danger of over-generalized and imprecise interpretation of the evidence to support a particular point of view.

The second principle that the Board should consider in evaluating salinity variability is that hypothetical salinity regime changes intended to control invasive exotic species which do not mimic historic salinity conditions should be based on the best available understanding of the salinity tolerances and environmental requirements of these species. The frequency, duration and timing of salinity intrusions and/or freshwater pulses will play a major factor in their potential efficacy in invasives control.

Freshwater flows continue to be the most strongly evidenced driver of ecological conditions in the Bay-Delta estuary, and the most reliable tool for protecting estuarine species and habitats

Freshwater flows through the San Francisco Estuary have a major impact on the productivity and distribution of aquatic organisms in this ecosystem (e.g., Jassby et al. 1995; Jassby 2005; Kimmerer 2004 and sources cited therein). The mechanisms (and the geography and timing of these mechanisms) underlying this relationship are likely to be species-specific. For example, critical life stages of some species occur upstream of the Delta (e.g. splittail spawning occurs in floodplain habitats; Chinook salmon spawning occurs in higher elevation river habitats); Delta inflow in the appropriate season is a valuable predictor of abundance for these life stages. Other important life stages and other species occur in the western edge or entirely downstream of the Delta where net Delta outflow is an appropriate metric by which to measure the impact of freshwater flows. Many species migrate through the estuary (e.g., sturgeon, splittail, striped bass, salmonids) and are impacted by inflow and outflow conditions during different life stages. Regardless of the mechanisms, freshwater flow through the estuary is a well-documented and remarkably influential force controlling fish species productivity in this estuary.

While a variety of factors influence estuarine species and habitats and should be addressed by the Board, it is highly likely that increasing freshwater flows through the system during particular seasons will have a beneficial impact of large magnitude on numerous estuarine fish species. This is because the positive relationships between freshwater flow and fish species abundance are:

1) statistically significant
2) numerous (i.e. appear in a wide variety of taxa)
3) historically consistent
4) logarithmic (i.e. high magnitude) in nature.

These reasons, alone and in combination, indicate that freshwater flows in the estuary are causally linked to protecting fish and wildlife beneficial uses identified in the Bay-Delta Plan, specifically the abundance and distribution of aquatic organisms and the quality and quantity of estuarine habitat.

Numerous studies document statistically significant relationships between freshwater flow (measured as inflow, outflow, or X2 position) and abundance of fish species and their favored prey items in the San Francisco estuary. Statistically significant relationships have been reported for:

- Chinook salmon (Stevens and Miller 1983; Newmark and Rice 1997; Brandes and McClain 2001);
- American shad (Stevens and Miller 1983; Kimmerer 2002);
- Longfin smelt (Stevens and Miller 1983; Jassby et al. 1995; Kimmerer 2002; Rosenfield and Baxter 2007; Sommer et al. 2007)

- Striped bass (*abundance*: Jassby et al. 1995; Sommer et al 2007 and *survival*: Jassby et al. 1995 and Kimmerer 2002)
- Sacramento splittail (Kimmerer 2002, *and see work by* Sommer and others *reviewed in* Sommer et al. 2008), and
- Starry Flounder (Jassby et al 1995; Kimmerer 2002)

Significant relationships between freshwater flow and abundance of important fish prey species have also been documented, including:

- the mysid shrimp, *Neomysis mercedis* (Jassby 1995, Kimmerer 2002[1]);
- the bay shrimp, *Crangon franciscorum* (Jassby et al. 1995; Kimmerer 2002) and
- spring populations of *Eurytemora affinis* (Kimmerer 2002).

These findings indicate that a large number of species respond positively to freshwater flow in the San Francisco Estuary. The number of these significant relationships (i.e. the number of species involved) strongly suggests that the correlations reflect a causal mechanism or suite of mechanisms that increase fish production as a result of increases in freshwater flow.

The relationship between flow and fish abundance has remained remarkably sturdy given the numerous other changes to the San Francisco estuary over the past several decades. Sometime during the 1980s, the San Francisco estuary ecosystem appears to have changed dramatically. For example, several studies document changes in primary productivity (the production of photosynthetic organisms at the base of the food web) in the estuary during that period (e.g., Alpine and Cloern 1992; Kimmerer 2002; Jassby et al. 2002; Lehman 2004). The apparent change in estuarine conditions has also been detected in some fish and invertebrate populations (Kimmerer 2002; Rosenfield and Baxter 2007). The reasons for this overall decline are a subject of intense research and debate and range from invasion of non-native filter feeding mollusks (e.g. *Corbula amurensis*), to the effects of climate change, to changes in water quality related to municipal and agricultural run-off, to sharply increased water exports, or other factors (Sommer et al 2007). However, even after the "step-change" in abundance is accounted for, freshwater flow in and through the estuary affects fish populations dramatically. For example, longfin smelt show a decline in abundance after the 1980s that is unrelated to delta outflow (Kimmerer 2002; Rosenfield and Baxter 2007). However, after accounting for that effect, the relationship of abundance with X2 or freshwater outflow from the Delta remains intact; the slope of that relationship has not changed significantly in any data set studied (Kimmerer 2002; Rosenfield and Baxter 2007; Sommer et al 2007). The

[1] The relationship between flow and mysid shrimp abundance appears to have changed sign, from positive to negative, in the past two decades. The reason for this shift is unclear. Mysid shrimp have experienced an extreme (~99%) decline in abundance suggesting they are impacted by changes in the estuary in addition to freshwater flow. It should be noted that, at extremely low abundance levels, sampling program results may not represent population size in the same way that they did historically and population dynamics may be dominated by demographic drivers – these effects could contribute to the shift in the nature of the mysid abundance:flow relationship.

slope of the relationship between freshwater flow and abundance has not changed for other estuarine species such as striped bass, Sacramento splittail, American shad, starry flounder, or *Crangon* shrimp (Kimmerer 2002; Sommer et al. 2008). For some species, there has been a change in the nature of the flow:abundance relationships (*Eurytemora affinis* now demonstrates a positive abundance:flow relationship; mysid shrimp populations seem to have lost their positive relationship with flow); these changes may reveal interesting ecological traits of the species involved or they may be statistical artifacts. As with the diversity of positive flow:abundance relationships seen in this estuary, the stability of these relationships over time implies that there is a mechanistic link between flow and population abundance of many of our estuarine dependant fish species.

The documented flow:abundance correlations are linear log:log relationships; thus, they explain huge amounts of variation in population size as a function of freshwater flows. Population levels for estuarine species are notoriously dynamic. Their high variability may be attributed to difficulties in sampling these populations accurately or to large-scale changes in driving forces that occur on multi-year time cycles (e.g. climate, nutrient loading). Also, estuaries are open systems where species dynamics and physical conditions beyond the ecosystem's boundaries can produce large changes in species composition and abundance from year to year. The flow:abundance relationships for this estuary correlate with population abundance over several orders of magnitude (factors of 10) as a function of freshwater flows that also vary over orders of magnitude. There is no evidence that the relationship between the variables (i.e. the slope of a statistical fit) changes over the range of freshwater flow or species abundance. That abundance of several species is correlated with freshwater flow over several orders of magnitude once again indicates that freshwater flow is powerfully connected to abundance in a causal manner. Also, the breadth of these relationships suggests that manipulating freshwater flow is a powerful tool for increasing the abundance and distribution of fish species in our estuary. The strongest signal from our scientific understanding of this estuary is that improving freshwater infows to the Delta and outflows to the Bay are critical to increasing protection of fish and wildlife beneficial uses.

<u>Eliminating or reducing the adverse effects on Bay-Delta species and habitat quality of the deficient fish screens at the state and federal water project pumping facilities are the first priority, before screening unscreened diversions</u>

Of the more than 2000 water diversions located within the Delta, less than 1 percent are equipped with fish screens designed and operated to meet the regulatory criteria promulgated by state and federal fisheries agencies to protect local estuarine and migratory fish species (including delta smelt and Chinook salmon). Scientific research and empirical evidence collected at screened diversions in the Delta have clearly demonstrated that positive barrier fish screens designed and operated to meet these criteria provide biological benefits by preventing entrainment loss of fishes (e.g., at

Contra Costa Water District's screened diversion on Old River few to no fish are lost). (*Cites?*) In contrast, scientific research and several decades of field data have shown that the fish protective facilities at the SWP and CVP export facilities, which are equipped with antiquated and deteriorating "louvers" rather than positive barrier fish screens and operated at flow levels substantially greater than those required by the present regulatory criteria, offer very little protection and have had (and continue to have) significant, population-level impacts on Delta fish species. For example, under most operational conditions, fewer than 50% of entrained fish are effectively screened by the louvers and are instead killed by the pumps. In addition, the design of the SWP intake, which utilizes a large forebay upstream of the louver facilities, has been shown to cause pre-screen mortality rates in excess of 75% (i.e., more than 75% of fish entrained by the SWP diversion die before reaching the louvers). Combined, these two diversions have a huge zone of hydrodynamic influence, affecting channel flows and habitat throughout more than a quarter of the legal Delta under most operational levels. Water diversion operations by the SWP and CVP cause high velocity reverse flows in both Delta channels that lead to their intakes. Each year, several million Delta fishes are killed at the SWP and CVP Diversions: new research has shown that the numbers of fish entrained into these two diversions is directly related to the magnitude of these reverse flows on Old and Middle Rivers. State, federal and academic fisheries scientists have shown that these entrainment losses are one of the principle causes for the recent population declines exhibited by a number of pelagic fish species, including Endangered Species Act-listed delta smelt. Recently published analyses of entrainment losses for delta smelt and Chinook salmon suggest that as much as 10-20% (or more) of these species' populations may be killed at these inadequately screened diversions each year (Kimmerer 2008). Compared to project impacts, screening unscreened agricultural diversions is a lower priority for Board action.

<u>Biological objectives should be considered by the Board as a tool for improving adaptive management and guiding the development of new management tools and permit conditions</u>

No rational approach to planning and regulation should rely on management of a single factor or subset of factors to provide full protection for fish and wildlife beneficial uses. This is particularly true for the Bay-Delta estuary, management of whose complex ecosystem is complicated by the degree of habitat alteration, the rate of climate change-induced effects, and the dire status of native fish populations and food web organisms. Establishing improved objectives for flow, salinity and water quality parameters is critical for protecting beneficial uses – but it is not sufficient in and of itself to achieve that goal as part of a comprehensive Bay-Delta Plan.

The Board should consider complementing the Bay-Delta Plan's abiotic objectives with specific biological targets for native fish species and food web organisms of special concern. Unlike the current narrative objective for doubling natural production of Chinook salmon, these objectives should be expressed as quantitative targets for the desired abundance, spatial distribution, and/or growth of delta and longfin smelt, Chinook salmon, splittail, sturgeon, and other priority species. Establishing such biological targets sets the stage for their incorporation into water rights permits and other rulemaking by the Boards and sets a benchmark for the allocation of water resources, funding and other assets by water rights permittees and other parties in a flexible and adaptive manner which augments the baseline protections afforded by the Plan's non-biological requirements.

Thank you for the opportunity to comment on issues relating to the periodic review of the Bay-Delta Plan and the upcoming evidentiary hearings. We look forward to working with you on turning the tide on the collapse of the Bay-Delta ecosystem.

Sincerely,

Gary Bobker
Program Director

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